UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/500,178	07/27/2004	Shigeaki Wachi	112857-373	5327

7590 05/16/2007

William E Vaughan
Bell Boyd & Lloyd
PO Box 1135
Chicago, IL 60690

EXAMINER	
YAKULIS, JEFFREY C	

ART UNIT	PAPER NUMBER
1709	

MAIL DATE	DELIVERY MODE
05/16/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/500,178	WACHI ET AL.	
	Examiner	Art Unit	
	Jeff Yakulis	1709	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 July 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 July 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *6/25/2004, 2/13/2007*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The disclosure is objected to because of the following informalities: it is improperly arranged. Appropriate correction is required.

The following guidelines illustrate the preferred layout for the specification of a utility application. These guidelines are suggested for the applicant's use.

Arrangement of the Specification

As provided in 37 CFR 1.77(b), the specification of a utility application should include the following sections in order. Each of the lettered items should appear in upper case, without underlining or bold type, as a section heading. If no text follows the section heading, the phrase "Not Applicable" should follow the section heading:

(a) TITLE OF THE INVENTION.
(b) CROSS-REFERENCE TO RELATED APPLICATIONS.
(c) STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT.
(d) THE NAMES OF THE PARTIES TO A JOINT RESEARCH AGREEMENT.
(e) INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC.
(f) BACKGROUND OF THE INVENTION.
    (1) Field of the Invention.
    (2) Description of Related Art including information disclosed under 37 CFR 1.97 and 1.98.
(g) BRIEF SUMMARY OF THE INVENTION.
(h) BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S).
(i) DETAILED DESCRIPTION OF THE INVENTION.
(j) CLAIM OR CLAIMS (commencing on a separate sheet).
(k) ABSTRACT OF THE DISCLOSURE (commencing on a separate sheet).
(l) SEQUENCE LISTING (See MPEP § 2424 and 37 CFR 1.821-1.825. A "Sequence Listing" is required on paper if the application discloses a nucleotide or amino acid sequence as defined in 37 CFR 1.821(a) and if the required "Sequence Listing" is not submitted as an electronic document on compact disc).

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-7, 9, 10, and 18-24 are rejected under 35 U.S.C. 102(b) as being anticipated by Maget et al. (6,171,368).

Regarding claim 1, Maget et al. teaches an electrochemical cell including a first electrode [110] for decomposing gas into ions, a second electrode [112] converting the ions generated in the first electrode into the gas again and an ion conductor [108 is ECM assembly] sandwiched in between both the electrodes; and a high pressure vessel disposed in one side of the electrochemical cell (figure 2B col. 5 lines 4-17 and col. 5 line 37-38).

Regarding claim 2, Maget et al. teaches a means for supplying control current to both the ends of the first electrode [110] and the second electrode [112], wherein a quantity of the control current is controlled to control the flow rate of gas flowing across both the electrodes (col. 12 lines 53-62).

Regarding claim 3, Maget et al. teaches the gas is hydrogen gas or oxygen gas (col. 5 lines 57-67).

Regarding claim 4, Maget et al. teaches the ion conductor is a film made of an electrolyte material capable of permeating the ionized gas (col. 5 lines 6-20).

Regarding claim 5, Maget et al. teaches the first electrode [110] and the second electrode [112] are electrode films on which a catalyst capable of ionic equilibrium of the gas is carried (col. 11 lines 50-54).

Regarding claim 6, Maget et al. teaches a low pressure vessel being disposed in the other side of the electrochemical cell, the electrochemical cell [108] serves as a gas partition wall and has a means for regulating pressure by controlling a potential between both the electrodes when a pressure difference is generated between both the sides of the electrochemical cell (figure 2B col. 5 lines 4-20 and col. 6 lines 48-59).

Regarding claim 7, Maget et al. teaches the force generated from the pressure difference is short-circuited or the pressure is regulated by a variable resistor (col. 4 lines 43-57; a variable resistor implies changing the direction of flow of electrons, which is done by the "controller").

Regarding claim 9, Maget et al. teaches both sides of the electrochemical cell serving as the gas partition wall have closed vessels, one side serves as a high pressure gas tank and the other side is connected to a gas consuming system (col. 5 lines 21-34), a pressure sensor is disposed in the closed vessel in the other side and the pressure sensor interlocks with a relay switch connected between both the electrodes of the electrochemical cell to function to compensate for the consumption of gas (col. 4 lines 38-62).

Regarding claim 10, Maget et al. teaches the electrochemical cell functioning as a gas refining filter (col. 10 lines 21-27).

Regarding claim 18, Maget et al. teaches a gas inlet and outlet part for introducing and discharging gas (figure 2B and col. 5 lines 4-34, oxygen is discharged through the membrane (outlet) and then the extracted oxygen can be routed to the cell battery (inlet)); a gas storage part for storing gas (col. 5 lines 24-25, notes the collection of gas); and an electrochemical cell disposed in the gas storage part and including a first electrode [112] for decomposing the gas into ions, a second electrode [110] for converting the ions generated in the first electrode in the gas again and an ion conductor sandwiched between both the electrodes (col. 5 lines 4-17); where the gas is supplied to or discharged from the gas storage part through the gas inlet and outlet port in accordance with the function of the electrochemical cell to decrease or increase the pressure in the gas storage part (figure 2B col. 5 lines 35-56).

Regarding claim 19, Maget et al. teaches a gas passage for supplying the gas to the gas inlet and outlet part provided in the gas storage device (col. 7 lines 6-23, notes movement of gas between two containers implying an inlet and an outlet and the container acts as a means of supplying gas), a pressure detecting means for detecting gas pressure in the gas passage (col. 4 lines 43-51), a voltage detecting means for detecting the voltage generated between the first and the second electrode (col. 14 lines 35-49, the ECM open circuit voltage is noted implying a voltage detection means), a calculating means for calculating a control current signal on the basis of the gas pressure and the voltage (col. 4 lines 38-62), a current supply means for generating a control current (col. 4 lines 38-62, a power source would supply a current), and a switching means for alternately switching a state that the control current is supplied

between the first electrode and the second electrode and a state that the voltage is detected until the voltage reaches a predetermined value (col. 4 lines 38-62).

Regarding claim 20, Maget et al. teaches a decomposing step of decomposing gas into ions in a first electrode [112], a conducting step of conducting the decomposed ions to a second electrode [110] side through an ion conductor sandwiched between the first and second electrode, and a converting step of converting the conducted ions to the gas again in the second electrode [110] (col. 5 lines 4-17).

Regarding claim 21, Maget et al. teaches wherein a control current is supplied to both ends of the first and second electrode [110] to control a quantity of the control current so that the flow rate of rate of gas flowing across both the electrodes (col. 12 lines 53-62).

Regarding claim 22, Maget et al. teaches an electrochemical cell [108] including a first electrode [112], a second electrode [110], and an ion conductor serves as a gas partition wall and when a pressure difference is generated at both sides of the electrochemical cell, a potential between both electrodes is controlled to regulate the pressure (Figure 2B and col. 4 lines 38-62 and col. 5 lines 4-20).

Regarding claim 23, Maget et al teaches the electromotive force generated from the pressure difference is short-circuited or the pressure is regulated by a variable resistor (col. 4 lines 43-57; a variable resistor implies changing the direction of flow of electrons, which is done by the "controller").

Regarding claim 24, Maget et al. teaches a high pressure gas storage tank is disposed at one side of the electrochemical cell [108] serving as the gas partition wall

and a closed vessel connected to a gas consuming system is disposed at the other side (Figure 2B and col. 5 lines 21-34), a pressure sensor is disposed in the closed vessel in the other side and the pressure sensor interlocks with a relay switch connected between both electrodes of the electrochemical cell to function to compensate for the consumption of gas (col. 4 lines 38-62).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. Claims 11-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maget et al. (6,171,368) as applied to claim 1 above, and further in view of Hinokuma et al. (WO 01/06519).

Regarding claim 11, Maget et al. teaches all the limitations previously mentioned in claim 1 but fails to disclose: an ion conductor being a proton conductor, the proton conductor is formed with a derivative by introducing a proton dissociation group to

carbon atoms forming a material which has, as a main component, at least a kind of material selected from a group including fullerene molecules, a cluster having carbons as a main component and a structural body having tubular or linear carbons, and the prton generated in the first electrode is moved to the second electrode through the proton conductor.

Hinokuma et al. is relevant because it is directed toward an ion conductor used within a gas diffusion electrode. Hinokuma et al. teaches an ion conductor being a proton conductor, the proton conductor is formed with a derivative by introducing a proton dissociation group to carbon atoms forming a material which has, as a main component, at least a kind of material selected from a group including fullerene molecules, a cluster having carbons as a main component and a structural body having tubular or linear carbons, and the prton generated in the first electrode is moved to the second electrode through the proton conductor (pages 21-23). Hinokuma also teaches that water vapor can be produced during the operation of electrochemical cells when using standard membranes such as Nafion produced by Dupont. This would require the presence of a dehumidifier (pages 1-3). The necessity of a humidifier gives rise to problems associated with enlarging the scale of the cell and raises the cost of the sytem (pages 1-3). The old membrane further only allows for a limited operating temperatures (pages 1-3)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to substitute the membrane of Hinokuma et al. into the pressure reducing device of Maget et al. in order to provide for hydrogen compression without

necessarily having to provide for a dehumidifier thus allowing for large scale systems to be produced, lowering the cost of the system, and an increased flexibility when choosing operating temperatures.

Regarding claim 12, Hinokuma et al. further teaches the proton dissociation group is –XH (X indicates an arbitrary atom or an atomic group having bivalent bonds and H indicates a hydrogen atom) (pages 21-23).

Regarding claim 13, Hinokuma et al. further teaches the proton dissociation group is –OH or –YOH (Y indicates an arbitrary atom or an atom group having bivalent bonds.) (pages 21-23).

Regarding claim 14, Hinokuma et al further teaches the proton dissociation group is a group selected from any of –OH, $-OSO_3H$, -COOH, $-SO_3H$, $-OPO(OH)_2$, and $-C_6H_4-SO_3H$ (pages 21-23).

Regarding claim 15, Hinokuma et al. further teaches the fullerene molecules are spherical shell type carbon cluster molecules Cm (m indicates a natural number in which Cm may form a spherical shell structure) (pages 21-23).

6. Claims 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Maget et al. as applied to claim 1 above, and further in view of Kosek et al. (6,685,821).

Regarding claim 8, Maget et al. teaches all the limitations previously mentioned in claim 1 but fails to disclose: a plurality electrochemical cells are arranged in parallel in a gas flowing direction and has a multistage structure.

Kosek et al. is relevant because it is directed toward an electrochemical cell used for hydrogen storage (col. 1 lines 6-9). Kosek et al. teaches a plurality of

electrochemical cells arranged in parallel in a gas flowing direction and having a multistage structure (figure 1-2, col. 2 lines 3-20 and col. 3 lines 30-55). Kosek et al. further teaches that this cell design is beneficial over previous hydrogen storage methods because it allows for safer operation and allows for a much simpler construction of the cell itself thus providing for cost savings (col. 1 lines 44-48 and col. 2 lines 3-20).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to use the cell stack design discussed by Kosek et al. and apply it to the gas storage device of Maget et al. because it allows for a much simpler construction of the cell itself and is safer during operation thus allowing for cost savings.

7. Claims 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maget et al. in view of Fuglevand et al. (6,218,035).

Regarding claim 16, Maget et al. teaches an electrochemical cell [108] including a first electrode [112] for decomposing hydrogen gas into protons, a second electrode [110] for converting the protons generated into the hydrogen gas again, and a proton conductor sandwiched between the electrodes (col. 5 lines 4-19 and col. 7 lines 56-58); a high pressure vessel disposed in the first electrode side of the electrochemical cell to accommodate a gaseous material including the hydrogen gas (Figure 2B and col. 5 lines 37-39), while Maget et al. uses oxygen as an example it is noted to be applicable to hydrogen (col. 7 lines 56-58), a gas consuming part including a pressure reducing part in which the electrochemical cell functions to reduce the pressure in the high pressure vessel (col. 5 lines 35-56).

Maget et al. fails to disclose: a third electrode disposed in contact with the hydrogen storage part to decompose the hydrogen gas supplied from the hydrogen gas storage part into protons, a fourth electrode for converting the protons generated into water, and a proton conductor sandwiched in between both the electrodes; the protons being converted into water in the fourth electrode to take out electrochemical energy between the third electrode and the fourth electrode.

Maget et al. however, does teach using the extracted oxygen from the container to power a metal-air battery (col. 12 lines 53-62). Maget et al. further teaches that these metal-air batteries have a battery life and are thus consumable and in need of replacement (col. 13 lines 34-53 and table 4). Maget et al. further notes the capability of the gas extraction device being applied to hydrogen (col. 7 lines 56-58). It should be further noted that a zinc-air battery uses oxygen as the primary fuel source and creates zinc oxide upon consumption of the oxygen gas. (Linden, D.; Reddy, T.B. (2002). Handbook of Batteries (3rd Edition). McGraw-Hill. pages 38.6-38.7).

Fuglevand et al. is relevant because it is directed to an apparatus using a proton exchange membrane fuel cell power system (col. 1 lines 14-21). Fuglevand et al. teaches a third electrode disposed in contact with the hydrogen storage part to decompose the hydrogen gas supplied from the hydrogen gas storage part into protons, a fourth electrode for converting the protons generated into water, and a proton conductor sandwiched in between both the electrodes; the protons being converted into water in the fourth electrode to take out electrochemical energy between the third electrode and the fourth electrode (col. 2 lines 5-28).

It would have been obvious to use the fuel cell design of Fuglevand et al. and incorporate into the device of Maget et al. first because the zinc air battery disclosed by Maget et al. would not function if exposed to hydrogen and one having ordinary skill would know this and thus substitute a power generating device that could. It would have been further obvious to one having ordinary skill in the art at the time the invention was made to substitute the fuel cell design of Fuglevand et al. into the device of Maget et al. because a fuel cell provides for a means of generating electricity without replacing the battery, where the zinc air battery discussed by Maget et al. requires replacement occasionally, thus this substitution of a fuel cell power device would allow for easier maintenance of the device.

Regarding claim 17, Fuglevand et al. further teaches oxygen gas or oxygen containing gas is supplied to a surface of the fourth electrode that does not come into contact with the proton conductor to react with the protons passing through the proton conductor and convert the protons into water, and the electrochemical energy is taken out between the third electrode and the fourth electrode (col. 2 lines 5-28).

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Patent (7,029,782) was reviewed as a possible double patent rejection, but ultimately not used because of the limitation: "a high pressure vessel disposed in one side of the electrochemical cell" claimed in instant application.

Japanese patents 62-210039A, 06-091143A, and 57-050510A demonstrate the state of the art.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jeff Yakulis whose telephone number is 571-272-9807. The examiner can normally be reached on M-F 7:30 AM-5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on 571-272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JCY
JCY

Alexa Neckel
ALEXA D. NECKEL
SUPERVISORY PATENT EXAMINER